The Impact of Scholar Stress on the Core Temperature of the Pupil

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Abstract: - It is known that the hypothalamus is playing a major role in stress pathogeny and thermoregulation. I am presenting in this paper the results of a study of the impact of the school stress during the knowledge evaluation of the secondary school pupils, changes in thermoregulation and the influence of the genetic and environmental factors on the changes of the central temperature during stress. The study comprises 203 school pupils of 5th-8th classes coming from two schools of the city of Sibiu, whom I supervised between 2006 and 2007. The school pupils were interviewed based on a questionnaire including personal characteristics, antecedents, school, familial and extracurricular habits. I measured the ear drum temperature during the first days after the holyday and during the knowledge evaluation. Ear drum temperature measured at the beginning of the semester, after psychical relaxation, registered variances (p=0.001) that depend of the school class (age of the pupil). The measurement of the ear drum temperature in maximum stress conditions showed a decrease of the ear drum temperature, from 35.674±0.038 0C to 35.390±0.038 0C, with the maintenance of the variance (p=0.038) between the school classes. The relation between the ear drum temperature and school timetable recorded lower core values (p=0.0074) in the school pupils who went to school in the morning. The decrease of the ear drum temperature as a result of stress preserved the negative relation (r=0.043) between the marks average and ear drum temperature, maintaining insignificant variances (p=0.362). The conclusion of my study was that psychical stress, as a result of knowledge evaluation, determines the decrease of the core temperature, observed through the ear drum temperature.

Key-Words: - Psychical stress, ear drum temperature, core temperature, thermoregulation, school environment

1 Introduction

According to Selye, stress is a syndrome, a constellation of non-specific responses, with a non-specific adaptation character [1]. During stress, processes such as wear or even lesions may occur, which are generally preceded, accompanied or brought about by physiological adaptation reactions, mediated by the neuro-vegetative-endocrine chains.

Disruptions in homeostasis (stress, for instance) generate the activation of two systems, within the organism: hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS). The activation of these two systems results in a series of neural and endocrine adaptations, known as “stress response” or “stress cascade”, necessary for the homeostatic equilibrium. The stressor initiates the release of corticotropin-releasing hormone (CRH) from the hypothalamus, which in turn results in the release of adrenocorticotropin hormone (ACTH) into general circulation. ACTH then acts on the adrenal cortex resulting in the release of a specific corticoid. The gluocorticoid acts in a negative feedback in order to terminate the release of CRH [2]. The neurons in the hypothalamic paraventricular nucleus synthesize CRH, as a response to the internal and external stimuli. CRH then reaches the median eminence through the axonic projections of the neurons. Subsequently, CRH is released in the portal blood and controls the transformation of ACTH into pituitary corticotropes. Blocking the actions of CRH with an antibody for this peptide or with a receptor-antagonist will prevent the stress-induced release of ACTH [3].

In 1912, Isenschmidt and L. Krehl drew the attention on the role played by the nervous system in temperature regulation [4]. The thermoregulation centres which preserve the thermal balance are placed in hypothalamus [5]. The afferents that activate the thermoregulatory centres come either from the thermo sensitive neurons in the anterior hypothalamus, or from the coetaneous receptors. The thermo sensitive neurons in the anterior hypothalamus are placed on a restricted area in the preoptic region [4, 6, 7]. Ear drum temperature is an indicator of the temperature of hypothalamus and of the body core temperature, the ear drum being strongly vascularized [8, 9, 10]. Even if the ear drum is not in direct contact with the brain, it may
perceive its temperature. The correlation between the tympanic temperature and the cerebral temperature was progressively validated, the tympanic temperature not being influenced by that of the environment or coetaneous [11].

2. Working hypothesis

The progress registered in the research of stress led to the conclusion of the existence of overstress in the school pupils – situation in which the school pupil finds himself in the secondary school, which makes the transfer from the school system with one teacher to that including more professors and disciplines, unequal in terms of importance and extension, with a large heterogeneity of the teaching staff – psychical stress generator factors.

The school pupil’s overstress in general and in special, the overstress recorded in the secondary school takes place during the knowledge evaluation.

The attempts made by the education establishments in order to reduce the school overstress by interposing intermediary holidays along the school year and through a permanent reorganization, still remain uncertain.

Having in view the part played by hypothalamus in stress pathogeny and in thermoregulation, I had in mind to monitor:

a). the impact of the school stress in evaluating the school pupils’ knowledge, on thermoregulation;

b). the part of the genetic and environmental factors in the changes of the core temperature during stress.

3. Material and method

The study comprises 203 school pupils, of the Vth and VIIIth classes from two general schools of the city of Sibiu, whom I personally supervised between 2007 and 2008. The batch comprises 96 school pupils coming from the General School No. 6, having German as the teaching language, a school which is placed in the centre of the city of Sibiu, with children with high social and socio-economic status, with a stable number of school pupils and with good learning results. There is a number of 107 school pupils, coming from the General School No. 21, with Romanian as the teaching language, which is also placed in the centre of the town, but with school pupils coming from families with less favoured economic situation and with a more reduced interest towards the training requirements regarding their own children (table 1).

When choosing the batch, I opted for the school pupils of the secondary school, who are right before puberty, in order to exclude the action of other hormonal factors specific for the puberty period of time. The study batches comprised healthy school pupils and with an Intelligent Quotient specific for their age.

Table 1. Repartition of the school pupils per schools and classes

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Vth class</th>
<th>VIth class</th>
<th>VIIth class</th>
<th>VIIIth class</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>General School No. 6</td>
<td>(German – as teaching language)</td>
<td>27</td>
<td>24</td>
<td>14</td>
<td>31</td>
<td>96</td>
<td>47.29%</td>
</tr>
<tr>
<td>General School No. 21</td>
<td>(Romanian – as teaching language)</td>
<td>28</td>
<td>25</td>
<td>24</td>
<td>30</td>
<td>107</td>
<td>52.71%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>55</td>
<td>49</td>
<td>38</td>
<td>61</td>
<td>203</td>
<td></td>
</tr>
</tbody>
</table>

The study was approved by the Schools’ Ethical Committee and took place after having obtained the parents’ consent regarding the participation of their own children in the study.

The individual study was accomplished based on an individual questionnaire including the identification data, school, class, domicile, age, parents’ profession and age, age and number of brothers, the age at which the school pupils went to school and timetable.

The data regarding the family environment aimed at the way of preparing the home works, length of sleep, the waking hour and the hour of going to bed, differentiated according to the training programme, sports practicing outside the school hours or different works within the household or going to discotheques.

The school environment aimed at the mean obtained in the semester previously to the investigation, the most favoured subject matter and the disliked one, the activities performed during holydays.

I have duplicate measured the ear drum temperature as the core temperature, as it is considered an index of the hypothalamus temperature, being more reliable than the axial temperature and it is not exposed to the fluctuations of the environment temperature.

The ear drum temperature was measured using a digital thermistor thermometer (Metron DP 10332) 90 seconds after its insertion into the external auditive channel and sensor application on the ear drum of the left ear.

With a view to exclude certain possible subjective factors, such as the fear for the device,
which could have been a stress-generator, I previously practiced the accommodation of the school pupils with the thermometer.

I personally measured the ear drum temperature during a period of maximum stress, as a result of the evaluation programme tests.

Before and after monitoring the ear drum temperature, I disinfected the device sound with alcohol wipes.

The results were statistically processed, using the plurifactorial ANOVA variance analysis, the Kruskal Wallis nonparametric test and Spearman’s rank correlation coefficient. [12,13].

I considered a p value less or equal to 0.05 as being statistically significant.

4. Results

The ear drum temperature measured at the beginning of the semester, after the psychical relaxation during the holyday, registered variations (p=0.001) according to the class.

Table 2. Core temperature before and within the knowledge evaluation, according to the class.

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>Core temperature</th>
<th>Temperature after stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>55</td>
<td>35.790±0.510</td>
<td>35.416±0.524</td>
</tr>
<tr>
<td>VI</td>
<td>49</td>
<td>35.655±0.516</td>
<td>35.431±0.580</td>
</tr>
<tr>
<td>VII</td>
<td>38</td>
<td>35.882±0.404</td>
<td>35.539±0.496</td>
</tr>
<tr>
<td>VIII</td>
<td>61</td>
<td>35.449±0.603</td>
<td>35.239±0.515</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>0.001189</td>
<td>0.038</td>
</tr>
</tbody>
</table>

Measuring the ear drum temperature in the conditions of maximum stress, following the evaluation tests, showed a decrease of the ear drum temperature, from 35.674±0.038°C to 35.390±0.038°C, with the maintenance of the variation (p=0.038) between the school classes. The correlation between the temperature measured during the relaxation period of time and that measured in stress conditions was highly significant (r=0.63).

Relating the ear drum temperature to the school timetable recorded more reduced core values (p=0.0074) in 61 school pupils who went to school in the morning. The decrease of the ear drum temperature during stress, manifested by all school pupils, preserved the timetable difference (p=0.046).

The school pupils who went to school in the afternoon manifested a larger decrease of the temperature after stress, explaining thus the reduction of the difference between the two means (table 3).

Table 3. Ear drum temperature (°C), core temperature and the temperature during the knowledge evaluation, taking into account the school pupil’s timetable.

<table>
<thead>
<tr>
<th>Timetable</th>
<th>n</th>
<th>Core temperature</th>
<th>Temp. after stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>61</td>
<td>35.492±0.623</td>
<td>35.268±0.519</td>
</tr>
<tr>
<td>Afternoon</td>
<td>142</td>
<td>35.756±0.489</td>
<td>35.444±0.539</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>0.0074</td>
<td>0.0460</td>
</tr>
</tbody>
</table>

The hour declared as the waking hour in the week days was between 6.30 and 11.00. The VIIIth class started the school programme in the morning, so the waking hour was between 6.30 –7.00.

The core temperature and the temperature after stress did not present any variances in any of the schools, taking into account the waking hour.

Among the school pupils with an afternoon timetable, the school pupils of the VIIth class excelled by a prolonged sleep, the waking hour of the majority of them being between 8.00 and 11.00, while most of the school pupils in the Vth and VIth class used to wake up between 8.00 and 9.00.

The hour for going to bed in the week days was between 20.00-24.00.

The majority of the school pupils of the Vth and VIth class used to go to bed between 21.00 and 22.00, while the school pupils of the VIIth class used to go to bed between 22.00 and 24.00, explaining the late waking hour in the morning.

The school pupils of the VIIIth class went to bed at 21.00-24.00.

Variances of the core temperature (p=0.796) and after stress (p=0.840) were not recorded in relation to the hour of going to bed in the week days.

The analysis of the ear drum temperature and the temperature after stress did not present any variances in relation to the waking or going to bed hour in the days off, in both schools.

The comparison of the learning means of the semester previously to the examination with the ear drum core temperature indicated a negative relation (r=-0.082), but the registered variances were not significant from the statistical point of view (p=0.221). The decrease of the ear drum temperature as a result of stress preserved the relation in negative terms (r=-0.043) between the marks average and the ear drum temperature, with the maintenance of insignificant variances (p=0.362).
The analysis of the core temperature per schools, taking into account the most favoured subject matter showed insignificant variances, both at the General School No. 6 (p=0.577) and at the General School No. 21 (p=0.135) and per total (p=0.649).

In both schools, the school pupils had preferences for the modern languages, existing only one difference – the German language – which was not studied at the General School No. 21.

The relation between the ear drum temperature and the disliked subject matter indicated mathematics, physics, chemistry and technological education, in both schools.

The school pupils from the General School No. 6 presented core values of the ear drum temperature with variances between the disliked subject matters. The decrease of the temperature after stress changed the variance of the means in relation to the disliked subject matter.

Regarding the General School No. 21, the core temperature did not present variances (p=0.340) in relation to the disliked subject matter. The decrease of the ear drum temperature as a result of stress preserved the variances (p=0.302) between the marks average and the disliked subject matter in the General School No. 21.

The disliked study discipline did not bring about variances of the core temperature (p=0.055) or of the temperature during the evaluation period of time (p=0.140) (table 4).

Table 4. Ear drum temperature (°C), core temperature and the temperature during the knowledge evaluation, taking into account the disliked subject matter.

<table>
<thead>
<tr>
<th>Disliked subject matter</th>
<th>n</th>
<th>Core temperature</th>
<th>Temperature after stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romanian</td>
<td>34</td>
<td>35.809± 0.482</td>
<td>35.382± 0.523</td>
</tr>
<tr>
<td>English</td>
<td>8</td>
<td>35.838± 0.239</td>
<td>35.513± 0.416</td>
</tr>
<tr>
<td>Drawing</td>
<td>3</td>
<td>35.967± 0.404</td>
<td>35.867± 0.231</td>
</tr>
<tr>
<td>Music</td>
<td>4</td>
<td>36.075± 0.096</td>
<td>36.5± 0.490</td>
</tr>
<tr>
<td>Mathematics</td>
<td>41</td>
<td>35.527± 0.690</td>
<td>35.334± 0.524</td>
</tr>
<tr>
<td>Physics</td>
<td>54</td>
<td>35.685± 0.594</td>
<td>35.405± 0.640</td>
</tr>
</tbody>
</table>

Most of the school pupils (70.4%) did their home works within 2-3 ore, but the school pupils of the VIIIth class assigned even up to 6 hours for the preparation of the home works.

The ear drum temperature did not present core variances (p=0.820) after stress (p=0.514) in relation to the number of hours assigned for doing the home works.

At the General School No. 6, there were no core differences or after stress differences of the ear drum temperature, regarding the school pupils who did their home works by themselves or with the help of the parents, brothers or private tutors.

The school pupils from the General School No. 21, who did their home works by themselves, presented higher core temperatures (p=0.015), but the difference between the means (p=0.082) was diminished after stress.

5. Discussions

The psychical stress brought about by the semester evaluation of the knowledge of the school pupils generated a decrease of the ear drum temperature.

Regarding the psychical stress, the influxes generated by the stressor agent led to the release of the corticotropin realising factor (CRF) by the peptidergic neurons of the tubero-pituitary duct of the hypothalamus, which was dependent on the stressor intensity.

CRF-secretory peptidergic neurons were neurogenically controlled through serotoninergic and cholinergic ducts and humorally, by vasopressin, adrenaline, serotonin, acetylcholine and gamma-aminobutyric acid [14].

The nervous circuits that intervened in thermoregulation also contained serotoninergic and adrenergic neurons [15].

Ear drum temperature represented the temperature of hypothalamus, the centre of
thermoregulation, being placed in the preoptic region of the anterior hypothalamus.

The decrease of the ear drum temperature, an exponent of the core temperature, indicated the fact that the psychical stress produced the release of the mediators of the mechanism that had been activated in conditions of stress.

The fact that the measurement of the ear drum temperature was made by the same person in all cases, excluded the error of the stress relative to the use of the device, through the familiarization of the school pupils with the device. Thus, I consider that I have reduced some of the subjective factors at maximum.

The more increased rate of response to stress in the school pupils learning at the General School No. 6 was mainly due to the requirements of their own families, regarding the high school performances. Parents’ excessive interest for a good preparation of their children’s home works, but without understanding their use, resulted in a sustained stress and fatigue of their children, with consequences on their psychical life and, implicitly on their school work [16].

In this respect, certain parents, although they come late from work, wish to control their children’s home works at all costs, which is a unilateral verification but which they consider enough. In case they notice mistakes, they ask their children to do again the home work, sometimes even twice or three times, situation in which the child, who is already overstressed by the effort he is submitted to such late hours, sleeps little and superficially, goes to school tired and he cannot focus on the lessons, does not understand what he is told – low efficiency, which on one hand may lead to a possible punishment from the part of the teacher and, on the other hand, it creates the premises for possible errors in doing the home works after school, with the well known series of consequences and with the gloomy perspective of overstress [16].

Ear drum temperature, not being influenced by the length of the sleeping hours in the days off, as well as by the time spent for doing the home works, proves the maturity of thermoregulation in this particular age, which does not allow the interference of certain transitory, short term factors.

Among the risk factors of the school environment, the afternoon timetable, the low learning mean and the disliked subject matter represent adjuvant risk factors of the psychical stress in the assessment of the school pupils’ knowledge.

The core ear drum temperature of the school pupils who go to school in the morning is due to the decrease of oxygen during the sleep, which is kept low even in the first hours after wake up. Heat production during night is lower than its loss, but the difference is insignificant. The wake up is accompanied by the maintenance of the temperature at the low level of the night, although we would expect that this should increase a lot [17, 18].

The low learning mean may represent an adjuvant factor of stress, especially in the case in which the huge effort the child is submitted to in order to distinguish himself – upon the insistent request of the parents, irrespective of his real possibilities – is not rewarded, the child becomes tired, discouraged and lives a bitter feeling of “hopeless exhaustion” (Alain). James Mill’s aphorism: “That person whom we never ask what he cannot do, will never do what he can do”, according to which such parents guide their lives, but without understanding it sufficiently, may contain a bit of truth. To persevere in something that is likely to turn the child in an unadapted child, first at school level, then at social level, means to prove a total lack of sense of reality in respect of pedagogical orientation. In their blind wish to see their children among the proficient school pupils – a warrantee, in their opinion, for a high position in society – parents sentence them to an immense suffering and a certain failure, with serious repercussions on children’s psychical life [16].

The marks average may represent a factor favouring the overstress in the school pupils with type A personality, characterized by ambition, perseverance, wish of accomplishing things the best they can, but who are more vulnerable to stress [19].

It is to be noticed the higher core temperature in the school pupils learning at the General School No. 21, who make their home works by themselves. In such cases, the lack of support confers them safety.

The analyzed genetic factor showed that the current age of the father and mother is not involved in the oscillations of the temperature after stress.

Regarding the specialized literature, I did not encounter any publication in relation to the involvement of the parents’ age in thermoregulation.

6. Conclusions

1. The psychical stress, generated by the knowledge assessment is responsible for the decrease of the core temperature, expressed through the ear drum temperature.

2. The afternoon timetable represents a risk factor for the psychical stress in the school pupils of the secondary school.

3. The response of the ear drum temperature to stress is in negative relation to the marks average.
4. The disliked subject mater is considered a stress favouring factor.

References: